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Mosaics of Winter Oats and Their Control in the Southeastern States[1]

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Mosaic was first observed in winter oats in the spring of 1943 by staff members of the Alabama Agricultural Experiment Station in the experimental plots at Auburn. In the spring of 1944, R. E. Atkinson,[2] of the Emergency Plant Disease Survey, United States Department of Agriculture, observed the disease in North Carolina and South Carolina, and the same year McKinney and Stanton observed it in Georgia as well as in the other States mentioned. Subsequent experimental work indicates that more than one mosaic is concerned.

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[1] Cooperative investigations of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration; the Alabama, South Carolina, North Carolina, and Georgia Agricultural Experiment Stations; and a commercial seed company at Hartsville, S. C.

[2] Atkinson, R. E. A new mosaic chlorosis of oats in the Carolinas. U. S. Bur. Plant Indus., Soils, and Agr. Engin., Plant Dis. Rptr. 29: 86–89, illus. 1945. [Processed.]

SUMMARY

Two mosaics occur in winter oats in limited areas in Alabama, Georgia, North Carolina, and South Carolina. The rosette reaction, which is very destructive, has appeared in a very few hybrid selections, but not in any named varieties. The virus causing rosette has not been identified as yet. These mosaics have been found mostly in experimental nurseries and are not widespread, hence their economic importance lies mainly in their threat to the winter oat crop. If these viruses become widespread in the winter oat region, very serious damage will result in several of the established varieties. Consequently, mosaic-resistant stocks should be favored in oat-breeding experiments.

The oat-mosaic viruses overseason in the soil, but are not seed-borne. They do not infect wheat in the field. Corn appears to be immune from these viruses.

Infection is favored by the cool autumn temperatures of near 60° to 65° F. for 35 to 60 days. For this reason these viruses are not likely to be of economic importance in most areas where oats are sown in the spring.

In yield comparisons made in nursery tests, mosaic reduced the grain yield of Letoria oats approximately 50 percent or more. When the virus infestation was eliminated from soil by chemical treatments, the yield of Letoria was increased approximately 44 percent.

Virus infestation in the soil can be eliminated by means of treatments with steam, formaldehyde, chloropicrin, or any one of several other chemicals.

Symptoms of mosaic mottling usually appear in the field at the time when spring growth starts. Mottling consists of light-green to yellow dashes, streaks, and sometimes eyespot patterns in the leaves. In late varieties of oats, these symptoms may not appear until the plants are well in the boot stage. All of the field and laboratory evidence indicates that these soil-borne, oat-mosaic viruses are distinct from the soil-borne wheat mosaic viruses previously studied.

Of the 91 named varieties of oats tested in mosaic-infested soil, 49 were sufficiently resistant to be regarded as safe for sowing in the infested areas, and of these 15 showed exceptionally high mosaic resistance. The remaining 42 varieties may be regarded as unsafe, and 7 of these show exceptionally high susceptibility to mosaic.

Many promising hybrid selections show high resistance to mosaic, and it appears that some of the mosaic-resistant varieties are resistant also to the root and stem rot caused by *Helminthosporium victoriae.*

RECURRENCE, DISTRIBUTION, AND IMPORTANCE

Oat mosaics have recurred in limited areas four successive seasons at Auburn, Ala.; three successive seasons at Experiment, Ga.; Clemson, Westminster, and Hartsville, S. C.; at Statesville, N. C.; and two successive seasons near Fallston, N. C.

Oat mosaics are not widespread as yet. They have been found mostly in experimental nurseries. Their economic importance therefore lies chiefly in their threat, insofar as the winter oat crop is concerned. If these viruses become widespread in the winter oat region, very serious damage will result in several of the established varieties and many varieties are likely to become unprofitable. Experience with wheat mosaic shows that work with the viruses of the winter cereals is important from the standpoint of insurance against possible mounting losses in these crops. Mosaic-resistant breeding stocks should be favored in the breeding programs.

All evidence now available indicates that the viruses under discussion will be of no economic importance in the spring oat areas.

MOSAIC VIRUSES OVERSEASON IN THE SOIL

In studies conducted by McKinney,[3] it was found that mosaic developed in oats grown at Beltsville, Md., in soils from the southern fields in which mosaic plants had grown the previous season. No mosaic occurred in oats grown nearby in the local Beltsville soil. Similar results were obtained later with infested soils collected at Hartsville and Clemson, S. C. Temperatures near 60° to 65° F. for 35 to 60 days, with a short daily photoperiod (8 to 9½ hours), have favored infection from the soil.

As in the case of the soil-borne wheat-mosaic viruses,[4] these oat mosaics have been controlled by steaming the soil and by treatments with formaldehyde solution containing 1 part of formalin (37 percent HCHO by weight) in 49 parts of water.

LOSSES

The reduction in grain yield caused by mosaic can be estimated from the behavior of Letoria oats, a susceptible variety. In tests conducted by one of the writers, Middleton, this oat variety has been among the highest yielding in North Carolina when sown on land that is not infested with the mosaic viruses. At Statesville, for 7 years (1939-41 and 1943-46) Letoria averaged 76 bushels per acre. During the same period, another variety, Fulwin, which is quite resistant to mosaic, gave an average yield of 73 bushels per acre. On

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[3] McKinney, H. H. MOSAICS OF WINTER OATS INDUCED BY SOIL-BORNE VIRUSES. Phytopathology 36: 359–369, illus. 1946.

[4] ——— INVESTIGATIONS OF THE ROSETTE DISEASE OF WHEAT AND ITS CONTROL. Jour. Agr. Res. 23: 771–800, illus. 1923.

the McCullers Branch Station, near Raleigh, N. C., where there was no mosaic virus infestation, Letoria and Fulwin averaged 58 and 61 bushels per acre, respectively, in a 4-year period.

In 1944, in a breeding nursery at Statesville, N. C., where the soil was heavily infested with mosaic virus, Letoria showed considerable injury, whereas Fulwin showed very slight signs of the disease. The average yields for seven rows of each of these two varieties were 37 bushels for Letoria and 61 bushels per acre for Fulwin. The incidence of mosaic is the only tenable explanation for the lower yield of Letoria.

During the season of 1945-46 at Clemson, S. C., a small yield comparison was made on Letoria oats (C. I. 3392) [5] grown in 20 small plots, 10 with and 10 without mosaic. Each plot was retained by a board frame 24 inches square and contained 2 rows of oats, each 2 feet long, sown at the rate of 1 gram of seed per foot. The area in which the tests were conducted was apparently free of mosaic virus, but as a safeguard the foundation soil of each plot was treated thoroughly with chloropicrin on September 4, 42 days before seeding. Tests have shown that this chemical controls or greatly reduces oat mosaic infestation in the soil. Twelve days before seeding, a layer of test soil 1¾ inches thick was placed on top of the treated foundation soil in each frame. In 10 of the plots this layer carried the virus infestation, and in the other 10 plots the infestation had been eliminated for all practical purposes by chemical treatments. In all 20 plots, the topsoils originated from a thoroughly mixed lot of virus-infested soil, the difference being in the treatments of the top 1¾-inch layers.

During the autumn and early winter, until signs of mosaic were apparent late in February, the plants in the 20 plots were essentially uniform and there was no suggestion of plant retardation or stimulation due to chemicals employed.[6]

After mosaic appeared in the spring, the oats in the plots with the treated layers of soil advanced more rapidly than did those in the infested plots. Furthermore, differences among the 10 plots in each series were too slight to be observed. In the 10 infested plots mosaic was especially strong and the symptoms persisted throughout the season. There were traces of mild mosaic in some of the 10 treated plots, but in no case was it of any apparent consequence. The results are presented in table 1.

[5] C. I. refers to accession number of the Division of Cereal Crops and Diseases.

[6] These observations were made by A. E. Prince, formerly assistant botanist, South Carolina Agricultural Experiment Station.

TABLE 1.—*Yield of grain* [1] *in mosaic-diseased Letoria oats grown in treated or untreated soil in small plots, 2 rows 2 feet long in each plot*

Treated soil [2]			Untreated soil [3]		
Plot No.	Plants with mosaic	Grain yield	Plot No.	Plants with mosaic	Grain yield
	Number	*Grams*			*Grams*
16	0	227.0	3	All	153.5
7	0	219.2	11	do	150.5
17	0	211.2	10	do	158.5
12	2	202.7	9	do	139.3
18	0	202.6	20	do	139.2
8	5	194.4	23	do	135.8
13	5	192.5	21	do	134.3
6	1	190.7	2	do	131.9
14	3	163.4	1	do	117.4
19	3	155.9	24	do	104.7
Total		1,959.6			1,365.1

[1] Total reduction in yield of grain, 30.0 percent.
[2] Average height of plants, 35 inches.
[3] Average height of plants, 30 inches.

The average increase in yield from the treatment was nearly 44 percent. This increase was attributed primarily to the absence and near absence of mosaic-virus infestation rather than to other factors resulting from the chemicals that were applied to the top layers of soil. From the studies by Weaver,[7] it is likely that most of the roots were in chloropicrin-treated soil below the top 1¾ inch layer.

Mosaics reduced the yield of grain 30.3 percent and also the plant height (table 1). The relative size of bundles of healthy and diseased plants is illustrated in figure 1. The healthy plants were grown in plot No. 16 (table 1), in which the originally infested soil had been treated with 30 percent ethyl alcohol in water for 24 hours, and the alcohol solution then evaporated 88 days prior to seeding. The diseased plants were grown in adjacent plot No. 11 (table 1) with infested topsoil. In both plots the undersoil had been treated with chloropicrin.

OAT MOSAICS NOT SEED-BORNE

Tests conducted at Beltsville, Md., indicate that mosaic is not transmitted through the seed.[8] These tests included the varieties Letoria (C. I. 3392), Victoria × Rainbow (C. I. 4191), and Iowa Winter Sel. 8 (C. I. 4466), the seed of which had been harvested from virus-infected plants at Clemson and Hartsville, S. C., and Statesville, N. C., respectively.

[7] WEAVER, J. E. ROOT DEVELOPMENT OF FIELD CROPS. 291 pp., illus. New York. 1926.

[8] See footnote 3.

FIGURE 1.—Two bundles of Letoria oats grown on areas of equal size: *A*, Plants had no mosaic; *B*, all plants had mosaic.

SYMPTOMS IN FIELD-GROWN PLANTS

In the more susceptible early and midseason varieties, the first signs of mosaic in the field appear as soon as the plants start spring growth. At Auburn, Ala., this may be from the middle of January to early February, and at Statesville, N. C., from late February to the middle of March. Symptoms may be delayed for several weeks in the more resistant varieties. In some of the late varieties, definite mosaic mottling may not appear until the plants are well advanced to the boot stage or later.

The infected leaves show chlorotic dashes, streaks, spots, and diffuse patches (figs. 2, 3, 4). Chlorosis ranges from very faint light green to yellow or ashen gray, depending on the oat variety, the strain of virus, and the seasonal conditions. The patterns are usually most evident in one to three upper leaves of the plants and frequently are massed toward the distal part of the leaf. In early and midseason varieties the severity of the chlorosis tends gradually to reduce with the development of the leaf and may disappear completely, tending to disappear last from the tip region. Eyespot patterns occasionally have been observed in leaves in the field. At first these spots are narrowly elliptical with greenish centers surrounded by zones of light green or yellow (fig. 3). Later there is a loss of plastid pigments and many of the leaves die prematurely.

In some seasons the signs of mosaic persist in the upper leaves until maturity, whereas in other seasons the symptoms do not persist. In many late varieties mosaic may fail to appear until the early boot stage when one to three of the top leaves will show (fig. 4) indications of the disease. In general, the mosaic symptoms are more evident when temperatures are cool.

A rosette reaction, which has the same appearance as the mosaic-rosette reaction in Harvest Queen winter wheat, has been observed in a few lines of oats (fig. 5 and table 4).

On February 22, 1946, at Clemson, S. C., the tips of leaves of mosaic-infected oat plants were noticeably susceptible to injury from frost, whereas practically no frost injury was noted in healthy plants in adjacent plots.

CAUSAL AGENTS

Studies reported previously [9] have shown that the causal agents can be transmitted to healthy plants by wiping the leaves of young seedlings with the juices from leaves and sheaths of mosaicked plants. Microscopic studies have failed to show any bacterium, fungus, or any other organism of microscopic dimensions associated with the mosaic tissues. The disease agents, therefore, are regarded as being of virus nature.

[9] See footnote 3.

FIGURE 2.—Apical mosaic on Letoria oat leaves compared with two sections of a healthy leaf at left.

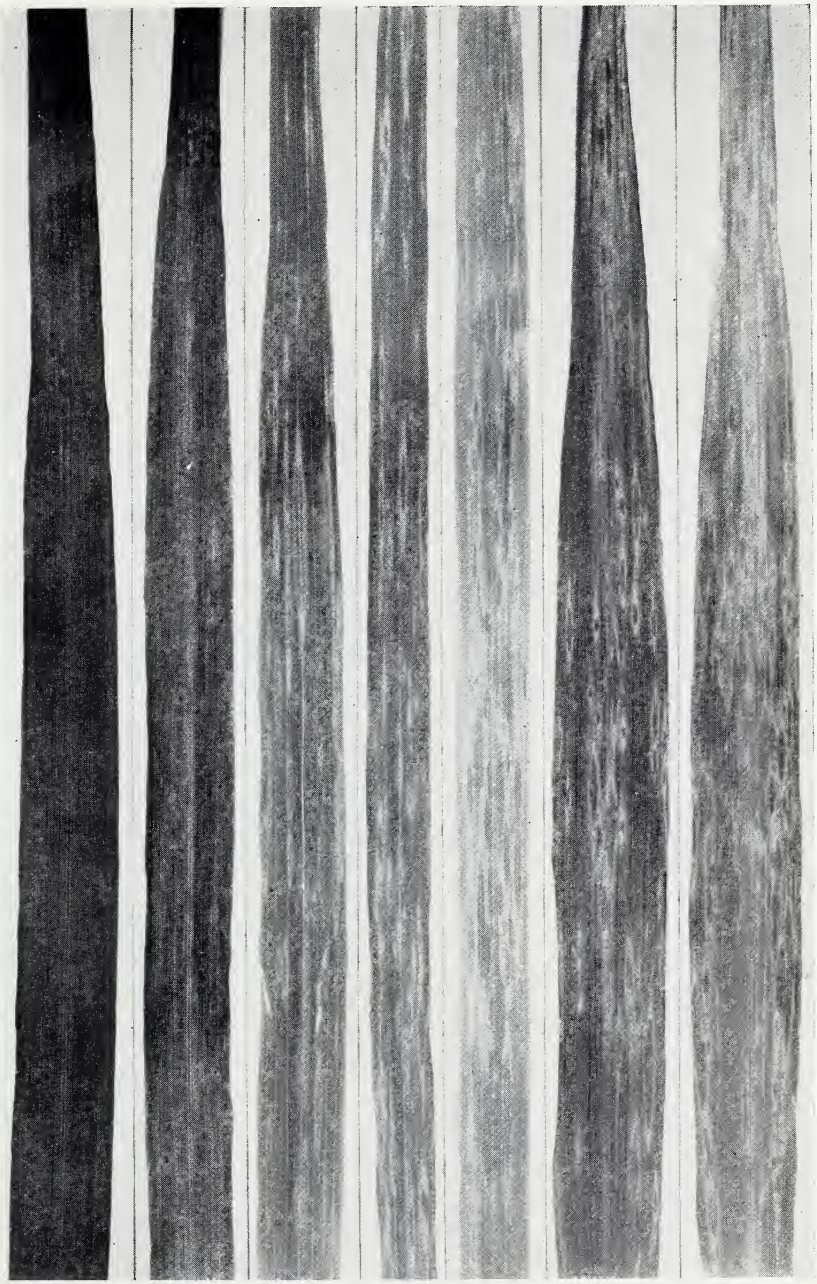

FIGURE 3.—Eyespot mosaic on Letoria oat leaves compared with one section of a healthy leaf at left.

At least two strains of virus are involved, one causing the apical-mosaic symptoms *(Marmor terrestre* var. *typicum* McK.) and the other causing eyespot-mosaic symptoms *(M. terrestre* var. *ocultum* McK.). The delayed symptoms appearing in some of the late varieties have not been studied experimentally and, therefore, cannot

FIGURE 4.—Coarse type of mosaic mottling on late-maturing oats collected in the field compared with healthy leaf at left.

be identified definitely with any particular species or strain of virus.

Because of the difficulty of transmitting these viruses by manual methods and of maintaining the isolates in pure culture, it has not been possible to study their properties. Also, it has not been possible to carry out tests to determine if oat rosette is induced by

FIGURE 5.—Rosetted oat plants compared with a healthy plant at the left. (Photograph by W. L. King.)

a strain of virus that is distinct from the two that have been described in oats.[10]

All field and laboratory evidence indicates that the soil-borne oat-mosaic viruses dealt with here are quite distinct from the soil-borne wheat-mosaic viruses.[11]

VARIETAL RESISTANCE

In 1944, there was some evidence of varietal resistance in the oat nurseries at Clemson and Hartsville, S. C., and Statesville, N. C. Conclusions could be drawn, however, in only a few instances, owing to lack of suitable control varieties and uncertainties with regard to the uniformity of virus infestation in the soils.

Extensive tests were conducted at Auburn, Ala., Clemson and Hartsville, S. C., and Statesville, N. C., from 1945 to 1947. Data were obtained also at Experiment, Ga., in 1946 and 1947. A few data were obtained from varietal tests conducted by the North Carolina Agricultural Experiment Station on virus-infested land near Fallston, N. C. Plantings were made in duplicate or in triplicate in rows 8, 14, or 16 feet in length. A mosaic-susceptible control (Letoria) was sown every fifth row to serve as a measure of the soil infestation. Two, and sometimes three, records of observations were made after the onset of the disease. Soil infestation was not uniform in all plots, but repeated tests showed rather consistent differences among varieties.

Seven wild or minor species of *Avena* were tested one season at Clemson, S. C.

An oat variety is regarded as being unsafe for general use on virus-infested land when its mosaic rating (tables 2 and 3) is severe (4) or very severe (5) or when the rating shifts from season to season between very mild to severe (1 to 4) and the maximum percentage of plants diseased reaches 75 percent or more.[12]

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[10] See footnote 3.

[11] McKINNEY, H. H. DESCRIPTIONS AND REVISIONS OF SEVERAL SPECIES OF VIRUSES IN THE GENERA MARMOR, FRACTILINEA, AND GALLA. Wash. Acad. Sci. Jour. 34: 322–329. 1944.

[12] After this manuscript was submitted, additional information revealed that some varieties believed to be safe are not safe under all conditions. The season of 1948-49 was especially favorable for mosaic, and in some test areas carrying heavy infestations it was evident that Anderson and Appler are not safe under such conditions. It is possible that some of the other varieties and lines that are given ratings of 1 to 3 and 1 to 4 and recommended as safe will be found to be unsafe when grown under conditions favoring very high incidence of mosaic.

TABLE 2.—*Reaction of varieties of oats tested on soils infested with the oat-mosaic viruses*

Variety or selection	C. I. No.	Plants with mosaic	Degree of mosaic reaction [1]	Recommendation [2]
		Percent		
Alabama Red Rustproof 43A	3934	90	1 to 3	S
Anderson	4651	10	1	S
Appler (Red Rustproof line)	1815	75	1 to 3	S
Bancroft (Red Rustproof line)	4468	80	1	S
Benton	3910	100	4	NS
Bicknell	3218	90	1 to 3	S
Bond	2733	100	4	NS
Bonda	4329	100	4	NS
Calcutta	994	95	1 to 2	S
Camellia	4079	100	5	NS
Carolina Red	4313	95	1 to 4	NS
Cedar	3314	100	4	NS
Clinton	3971	100	4	NS
Coker 43-33 (Lee × Victoria)	4315	100	1	S
Culberson	273	5	1	S
Culred	3217	80	1 to 4	NS
Custis	2041	50	3	S
Delta Red 88 (Red Rustproof line)	4220	75	1 to 3	S
DeSoto	3923	90	2 to 3	NS
Ferguson 922 (Red Rustproof line)	2150	95	5	NS
Florilee	4060	100	4	NS
Forkedeer	3170	10	1	S
Fulghum	708	80	1 to 2	S
Fulghum (Marett)	3919	75	1 to 3	S
Fulghum (winter type)	2498	[3]	1	S
Do	2499	5	1	S
Do	2500	75	1	S
Do	3172	5	1	S
Fulgrain (Coker 45-237)	4556	90	3	NS
Fulgrain Strain 3	3697	10	1	S
Fulgrain Strain 6	4205	75	1	S
Fulgrain Strain 7	4389	75	1 to 2	S
Fulgrain Strain 8	4555	100	3	NS
Fultex	3531	80	1 to 3	S
Fulwin	3168	10	1	S
Hairy Culberson	2505	90	1 to 3	S
Hastings Hundred Bushel (Red Rustproof line)	2462	75	1	S
Illinois No. 11 (Clinton type)	4606	100	1 to 4	NS
Iogold	2329	100	5	NS
Iowar	847	100	4	NS
Iowa Winter Sel. 8 (Winter Fulghum type)	4466	95	1	S
Klein Capa	4232	100	3 to 4	NS
Klein Mar	4233	100	3	NS
Klein Victoria	4234	100	3	NS
La Prevision 13	4235	0	—	S
Lee	2042	50	1 to 4	S
Lee 5	3755	50	1 to 3	S
Lega	3379	100	4	NS
Lelate	3391	100	4	NS
Lelina	3404	100	4	NS
Lemont	4080	90	1 to 2	S
Leroy	3398	100	4	NS

TABLE 2.—*Reaction of varieties of oats tested on soils infested with the oat-mosaic viruses*—Continued.

Variety or selection	C. I. No.	Plants with mosaic	Degree of mosaic reaction [1]	Recommendation [2]
		Percent		
Letoria	3392	100	4	NS
Levic	3384	100	4	NS
Marmac	3963	95	2 to 3	NS
Mindo	4328	100	4	NS
Minrus	2144	100	4	NS
Neosho	4141	100	4	NS
New Nortex (Red Rustproof line)	3422	75	1	S
Nortex (Red Rustproof line)	2382	75	1 to 3	S
Osage	3991	100	5	NS
Pioneer	3427	90	1 to 3	S
Quincy Red (Quincy 1)	4077	95	2 to 3	NS
Ranger	3417	100	5	NS
Rangler	3733	95	1 to 2	S
Rustler	3754	100	5	NS
Sevnothree	3251	100	4	NS
Stanton (Coker 40-33)	3944	100	3	NS
Stanton Strain 1	3855	100	2 to 4	NS
Stanton Strain 2	4390	100	2	S
Traveler	4206	100	5	NS
Tech	947	50	1 to 3	S
Tennex	3169	25	1	S
Terruf (Ga. P821)	3479	5	1	S
Tifton 8110 (Lee × Victoria)	3922	100	4	NS
Verde	4312	100	4	NS
Victorgrain	4685	70	1 to 2	S
Victorgrain (Block 45-3)	4557	90	1 to 2	S
Victorgrain (Coker 45-10)	4561	10	1	S
Victorgrain Strain 3	4098	80	1 to 3	S
Victorgrain Strain 4	4314	75	1 to 3	S
Victorgrain Strain 5	4388	75	1 to 3	S
Victorgrain Strain 6	4554	90	1 to 3	S
Victoria	2401	100	4	NS
Westdale	3101	95	3	NS
Winter Resistant (Marett)	3920	10	1	S
Winter Resistant Strain 3	4394	5	1	S
Winter Resistant Strain 4	4395	5	1	S
Winter Resistant Strain 5	4396	(3) [1]	1	S
Winter Turf	3296	80	3	NS
Wintok	3424	90	1 to 3	S

[1] The degrees of mosaic expression are evaluated as follows: 1=Very mild (difficult to see); 2=mild; 3=moderate; 4=severe; 5=very severe (strong mottling and streaking of leaves with light green to yellow, with or without pronounced expression of anthocyanin pigments).

[2] The letter S signifies that the variety is regarded as being safe for use in areas where mosaic-virus infestation occurs; the letters NS signify that the variety is not safe in such areas.

[3] Trace.

TABLE 3.—*Reaction of certain oat hybrid selections on soils infested with the oat-mosaic viruses*

Hybrid	C. I. No.	Plants with mosaic	Degree of mosaic reaction [1]	Recommendation [2]
		Percent		
Coker B-197 × (D69-Bond) × Iowa Winter 8	4708	50	1 to 4	S
Coker B-201 × (D69-Bond) × Iowa Winter 8	4709	40	1 to 4	S
Fulghum (H. C. 726) × Bond	4076	75	1	S
Fulghum (H. C. 726) × Bond Sel. 4076-1	4652	10	1 to 2	S
Fulghum (H. C. 726) × Bond Sel. 4076-16	4653	10	1	S
Fulwin × (Lee-Victoria) (Sel. 3824-1)	4219	75	1 to 4	NS
Ga. H842-1-1-12-X-4-X-50	4448	30	1 to 2	S
Ga. H842-1-29-X-1-9-1-2-3	4574	10	1	S
Hairy Culberson × Victoria	3411	75	1 to 3	S
Lee × Bond	4379	90	1 to 2	S
Lee × Fulghum (Marett acc. No. M 712)	4399	25	1	S
(Lega-Fulwin) × (Lelate-Victorgrain)	4417	30	1 to 2	S
(Lega-Winter Resistant 5) × (Lega-Victorgrain)	4411	50	1	S
(Lelate-Victorgrain) × (Red Rustproof-Lega)	4413	10	1	S
Letoria × Fulwin	4479	20	1 to 2	S
Nortex × Victoria	3534	80	1 to 4	NS
Red Rustproof × (Victoria-Richland)	3955	90	1 to 4	NS
Palestine × Dawn	4230	100	2	NS[3]
(Red Rustproof-Lega) × (Fulgrain Strain 4-Lelate)	4415	5	1	S
Red Rustproof × [Red Rustproof × (Victoria-Richland)]	4322	90	3 to 4	NS
Victoria × Norton	4318	100	1 to 4	NS[3]
Victoria × Rainbow	4191	100	5	NS
Winter Resistant Strain 3 × Lelate	4403	15	1	S

[1] See footnote 1, table 2.
[2] See footnote 2, table 2.
[3] In addition to mosaic, part of the plants had rosette.

Of the 91 named varieties of oats tested in virus-infested soil (table 2), 49 are regarded as safe for field production. Of these latter, 14 developed very mild mosaic in 10 percent or less of the plants, and 1 variety, La Prevision 13,[13] was free of mosaic in the one season it was tested at Experiment, Ga. All of the varieties listed in table 2 with very mild to moderate symptoms have failed to show signs of mosaic in some seasons when the more susceptible varieties showed much mosaic.

[13] La Prevision 13 showed mild mosaic in 2 percent of the plants tested in 1948 at Experiment.

Seven varieties have had very severe mosaic in a high percentage of the plants each season they were tested and are regarded as extremely unsafe for general use on virus-infested land. Thirty-five other varieties have shown severe mosaic in a high percentage of the plants and are regarded as unsafe for commercial production in infested areas.

None of the named varieties tested has expressed signs of rosette.

Hundreds of selections from hybrids have been tested once, and some of the best of these have been given several tests. It does not seem feasible to present a full tabulation of the results of all these tests. However, 16 of the best combinations and 7 of the poor ones are listed in table 3, and all of those showing rosette, 12 in all, are listed in table 4.

TABLE 4.—*Oat hybrid selections that showed a rosette reaction in addition to mosaic when grown in some of the mosaic test nurseries*

Hybrid	C. I. No. or source	Degree of rosetting
(D69-Bond) × Iowa Winter 8 (Sel. 41-1)	Coker's Pedigreed Seed Co.	Much.
(D69-Bond) × Iowa Winter 8 (Sel. 57-4)	do	Do.
(D69-Bond) × Iowa Winter 8 (Sel. 57-5)	do	Do.
(Fulghum-Markton) × (Victoria-Richland-Fultex) (sel. 1-1)	do	Moderate.
Iowa Winter × (Bond-Double Cross) (sel. 148-1-4) H. R. 2718 Blk. 45-34	do	Much.
Iowa Winter 10 × (Bond-Double Cross) (sel. 145-1)	do	Do.
Palestine × Dawn	4230	Do.
Tenn. 1922 × (Bond-Iogold)	4212	Do.
Do	4214	Do.
Do	4700	Do.
(Victoria-Richland) × Victorgrain (Sel. 243-5)	Coker's	Moderate.
Victoria × Norton	4318	Do.

The rosette reaction is very destructive, and selections showing it should be avoided in breeding for mosaic resistance.

The results of these studies indicate that oat mosaics caused by the soil-borne viruses discussed here can be controlled by selection and breeding.

In tests conducted by Stamper and Forbes in Louisiana and reported at the meetings of the Southern Division of the American Phytopathological Society in 1948, high resistance to *Helminthosporium victoriae* Meehan and Murphy was obtained in the seedling stage with the varieties Appler, Hastings Hundred Bushel, Lee, and Nortex. In table 2 it will be observed that these varieties have shown high resistance to mosaic, indicating that factors for resistance to these diseases may be combined.

Two of the seven wild or minor species of *Avena (A. brevis* and *A. fatua)* (table 5) manifested no signs of mosaic. Four showed traces of mosaic and one *(Avena abyssinica),* a very early type, showed mosaic in all the plants on March 14. On April 5 there were no signs of mosaic, whereas on May 23 two *(A. fatua* var. *glabrata* and *A. sterilis* var. *ludoviciana)* had developed marked signs of mosaic in the flag leaf and the leaf next below in 50 and 100 percent of the plants, respectively. Some seasons this late expression of mosaic has been evident among the late lines of oats being developed for forage purposes.

TABLE 5.—*Reaction of wild and minor species of Avena on soil infested with the oat-mosaic viruses in Clemson, S. C., in 1946*

Species and variety	Plants with mosaic on—		
	March 14	April 5	May 23
	Percent	*Percent*	*Percent*
Avena abyssinica (white-seeded) (C. I. 2108)	100	[1] 0	0
A. barbata	(2)	0	0
A. brevis	0	0	0
A. fatua [3]	0	0	0
A. fatua var. *glabrata*	(2)	0	[4] 50
A. sterilis var. *ludoviciana*	(2)	0	[4] 100
A. strigosa var. *glabrata*	(2)	0	0

[1] On April 5 this species was in full panicle. On March 14 the mottling was very severe, yet there were no signs of mottling in the later foliage.

[2] Trace.

[3] From a collection made in China by H. H. Love.

[4] Mosaic mottling was moderate to strong in the flag leaves and the leaf next below.

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